

SECTION 8.0 SANITARY SEWER

8.01 Sanitary Sewer Pipe

All sanitary sewer pipe shall be Poly-Vinyl Chloride or Cement Lined Zinc Coated Ductile Iron (pressure class 350 min.).

These standard specifications for sanitary sewer pipe are intended for sizes up to and including 15" in diameter. Material and Construction Specifications for pipe sizes in excess of 15" in diameter shall require approval by the City Engineer.

It is the intent of this specification to provide pipe of the highest standard known to the trade and to provide pipe that is free from defects in workmanship and materials.

All pipe and other materials shall be first class and no used or second hand pipe or materials will be permitted.

For depths of cover over pipe three feet or less, only ductile iron sewer pipe may be used.

For depths of cover over pipe greater than three feet, but less than twenty feet, PVC or Cement Lined Zinc Coated Ductile Iron may be used.

For depths of cover over pipe in excess of twenty feet, only Cement Lined Zinc Coated Ductile Iron may be used. Thickness of DIP shall be as specified by the City Engineer.

Clearing

The Contractor will be required to clear, remove, or dispose of all natural, artificial, or man made obstructions to the construction as indicated on the Project Plans, or as may be evident at the time of the bidding of construction. The Contractor will be required to restore the construction area as close as is practical to the condition he found it.

Contractor shall be familiar and comply with all restrictions imposed by Clean Water 401/404 or other permits.

All trees, stumps, roots and other debris shall be removed and properly disposed of by the Contractor.

Fences, mailboxes, street signs, small shrubs, driveways, roads, sidewalks, curb and gutter, walls, drainage systems, poles and cables, etc., shall be protected. If damaged they shall be restored by the Contractor to a condition equal to that existing at the date of award of the Contract.

Any open cuts approved by the City shall be restored with asphalt/concrete the same day as the disturbance began. All disturbed areas shall be seeded, mulched, and tacked no later than **seven (7) days** after the land disturbing activity started.

For Special Conditions requiring ferrous material pipe see Section 2.10.

8.02 Cement Lined Zinc Coated Ductile Iron Sewer Pipe

Ductile Iron Pipe shall be manufactured and tested in the U.S.A. and shall conform to AWWA Specification C 151 and ANSI Standard #A21-51 or latest revision.

Cement linings for ductile iron pipe shall conform to AWWA Specification C 104.

Exterior of ductile iron pipe shall be coated with a layer of arc-sprayed zinc per ISO 8179. The mass of zinc applied shall be 200 g/m² of pipe surface area. An asphaltic topcoat layer shall be applied over the zinc to a minimum 2 mil thickness. Zinc coating system shall conform to ISO 8179-1 "Ductile iron pipes – External zinc based coating - Part 1, Second edition 2004-06-01 or latest revision.

Ductile iron pipe shall be mechanical joint or push-on joint type. Push-on joints shall be "Bell-Tite," "Fastite" or approved equal. All joints for ductile iron pipe shall conform to the applicable dimensions and weights shown in the tables in AWWA C151 and to ANSI A 21.11 (AWWA C111) or latest revision.

All pipe shall be clean and sound without defects that will impair their service. Repairing of defects by welding or other methods shall not be allowed. All pipe shall have an outside petroleum asphaltic coating of approximately 1 mil thick. The coating shall be applied to the outside of all pipe and the finished coating shall be continuous, smooth, neither brittle when cold, nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.

Thickness for all Ductile Iron Pipe in shall be as recommended for the proposed depth of cover in the May 2016 “Design of Ductile Iron Pipe” handbook as published by the Ductile Iron Pipe Research Association, or as shown on the Project Plans (with the minimum being Pressure Class 350).

Polyethylene Encasement - See Section 9.03

Solid Sleeves - See Section 9.06

8.03 PVC Sanitary Sewer Pipe and Fittings

PVC sewer pipe may be permitted only in areas that generate domestic sewage, are zoned for residential use, and where all up stream drainage areas have residential zoning designations and uses. PVC sewer pipe may be installed in some commercial development; however, each project must be evaluated and approved by the City Engineer on a "case by case" basis.

When **8" thru. 15"** diameter polyvinyl chloride (PVC) pipe is specified on the approved project plans, unless otherwise specified, the PVC pipe shall be as specified in ASTM D-3034 with a Standard Dimension Ratio (SDR) of 35, PVC sewer pipe shall be furnished with an integral bell and elastomeric gasketed joint permanently installed at the factory in accordance with ASTM D-3212 and ASTM F-477. The pipe shall be furnished in nominal lengths of 13 feet or as approved 20 feet, shall be green in color, and shall be manufactured and tested in the U.S.A.

All PVC gravity sewer pipe shall be manufactured from material meeting the minimum requirements of cell classification 12454, or 12364-B as per ASTM D1784. The pipe manufacturer shall certify that this requirement has been met, and the pipe shall be appropriately marked according to ASTM specifications.

Sewer and Water crossings shall be as specified in Section 2.10 of the City of Gastonia Standard Specifications. Couplings for jointing PVC to ductile iron pipe (DIP) sewer pipe shall be as listed in the City’s approved material list or as specifically approved.

All fittings used on PVC sewer mains including tees for taps, shall meet the same specifications as those of the PVC sewer main. To couple the tapping tees to the sewer lateral bend, it will be necessary to use an SDR 35 to Schedule 40 PVC slip-by-hub adapter. See Section 8.18 of the City of Gastonia Standard Specifications for tap requirements.

The Contractor shall provide adapters, seals, and transitional pieces as required for connecting to other pipe or structures shown on the Drawings or indicated in the bid documents. Flexible repair couplings will not be allowed. Any field cut ends shall be as per the pipe manufacturer's and AWWA’s recommendations.

In all instances PVC pipe shall be installed in an acceptable manner, true to line and grade, with the bell ends facing up-grade. The various pipes, referred to herein, shall be handled, belled up and installed in accordance with the manufacturer's recommendations and established engineering practices as described in the various publications referenced in this document. See section 8.15 also.

All PVC pipe shall be shipped, stored, and placed at the project site in a manner so as to be protected from total accumulated exposure to sunlight and ultra violet radiation of no more than six (6) months, no defects shall be visible. Any visible defects including but not limited to chalking, discoloration, blisters, or loss of sheen shall be cause for the pipe to be rejected and replaced. Any testing suggested in lieu of the above shall be at the manufacturer's expense, all such test shall be performed by an independent laboratory.

Class B bedding as described on Standard Detail 71B-5A latest revision shall be used with all PVC sewer pipe. These installation requirements shall be as specified in ASTM D-2321, latest revision, Type IA Granular Embedment (# 57 washed stone) regardless of ground water or soil conditions; the bedding shall be installed to 95% Standard Proctor. Native materials of Classes II, and III may be used above the pipe springline and shall be placed and compacted as specified in the City of Gastonia Standard Specifications. The minimum depth of cover shall be 3 feet and the maximum depth of cover shall be 30 feet (Depths greater than twenty feet (20') require pre-approval by the City Engineer).

No backfill may be placed over the PVC pipe until the City Engineer or his designated representative has visually inspected the gravel bed and PVC pipe installation. If for any reason backfill is placed prior to the inspection, the contractor will be required to remove the backfill to allow for this visual inspection. All cost for said removal and replacement of backfill, as well as any defects found, shall be at the contractor's and/or developer sole expense.

In addition to other tests, including but not limited to Section 8.17 of the City of Gastonia Standard Specifications, a deflection test will be required to be performed not less than 30 days following completion of backfill operations. The contractor shall supply all labor, equipment, and materials necessary to pull a mandrel sized for a maximum of 5% deflection of the actual pipe inside diameter, as defined in ASTM D-3034. The mandrel shall be provided by the **contractor unless the City of Gastonia decides to supply it**. The mandrel shall be pulled through each section of pipe from manhole to manhole. The mandrel must slide freely through the pipe with only a nominal hand force applied. No mechanical force shall be used in pulling the mandrel. Any pipe which refuses the mandrel shall be removed and replaced and the bedding shall be properly constructed as specified to prevent excessive deflection. Such sections shall be re-tested after completion of backfill. all cost for such testing, removal, and replacement shall be at the contractors and /or developers sole expense. If a developer desires to use PVC sewer pipe, PVC sewer pipe must be used throughout the development unless DIP is required and is shown on the plans approved the by the City Engineer.

8.04 Manholes

Manholes shall be built where shown on the plans and shall be in accordance with City Standard No. 71B-1 thru 71B-4B and these specifications. Distance between manholes shall vary as shown on the plans, but the maximum distance between manholes shall be four hundred twenty five feet (425') for sewer mains and five hundred feet (500') for outfall lines. Venting shall be provided at intervals not to exceed 1,000'.

Inverts are to have a smooth finish and shall conform to City Standard No. 71B-4 in cross-section. There shall be a minimum drop of 0.2 feet within the manhole, but in no case shall it exceed two and one half feet (2-1/2') , unless an outside drop is constructed. Manhole walls shall be pre-cast unless special permission is given for block or brick construction.

Manhole bottoms shall be constructed of 3000 PSI Class "A" concrete and shall be a minimum of six inches (6") in thickness.

When required by the City Engineer, the foundation for the manhole bottoms shall be stabilized by placing No. 57 washed stone in the excavation.

Manhole steps shall be provided and installed in accordance with City Standard Detail 71B-2. Manhole steps shall be made with a No. 3 reinforcing rod encapsulated in a polypropylene plastic, and shall be as shown on the City's approved materials list or specifically approved by the City Engineer.

Cast iron manhole covers and frames shall be furnished and installed in accordance with City Standard No. 71B-1. Manhole covers and frames shall be set in mortar with even bearing. Installations outside the roadway shall be set on buytl rubber sealant and mechanically secured; bolts shall be covered in concrete mortar.

As a normal policy, all manhole rim elevations in well maintained areas such as streets, parking lots, yards, ball fields, etc., shall be set flush with the existing grade. Manhole rims set in fields, pastures, woods, etc. , shall be set 6" above the natural existing grade and backfilled flush with the rim with a maximum slope of 4:1. Manhole rims in flood plain areas, shall be set two (2) feet above the 100 year flood elevation; or a sealed manhole shall be set flush with the natural existing ground and vented according to Standard Detail 71B-4A and as shown on the project plans. The City's inspector may vary from this policy if special field conditions warrant it.

Plugs and sealed stubs shall be placed as required by the plans or as directed by the City Engineer.

Contractor shall follow manufacturers recommendations for internal and external seals of all pre-cast joint sections.

The masonry height for adjustment of grade above the cone shall be 12 inches maximum.

Manholes shall be cleaned, and in good order, and so kept until final acceptance of the job.

*****Block and brick manhole specifications are included herein for use with the repair of existing structures only. All new (proposed) manholes shall be as specified in Section 8.07 herein.**

8.05 Manhole Brick

All manhole brick used shall be hard rough, sound clay brick of first class quantity, especially suitable for this class of work and shall conform to ASTM Standard No. C-62 or latest subsequent revision. Over-burned brittle brick or brick from benches of kilns shall not be accepted. The brick shall be set at the time of laying, except when liable for freezing. The brick shall be laid with full shove joints, filling up the joints with mortar and the thickness of the joints on the inside of the walls must not be more than three-eighths (3/8") of an inch in width.

8.06 Manhole Block

All manhole block used in construction shall be a standard six inch (6") thick concrete manhole block and shall conform to ASTM Standard No. C-139 or latest subsequent revision and shall as shown on the City's approved materials list or an approved equal. The manhole shall be constructed of two (2) types of block, the barrel block and the battered entrance block. The barrel block shall form the main body of the manhole and shall form a cylindrical section. The Standard inside diameter of the cylinder shall be four feet (4') for manholes up to fourteen feet (14') in depth and five feet (5') for manhole sections greater than fourteen feet (14') in depth. The top battered section shall form a conical section which shall have a four foot (4') diameter base and shall be constructed of four (4) courses of eight inch (8") high battered blocks. These blocks shall be designed so as to reduce the inside diameter by six inches (6") per course. The top diameter of the manhole shall be twenty-four inches (24"), and shall be the standard opening needed for the cast iron manhole ring. The blocks shall be embedded in a mortar bed to form 1/2" horizontal mortar joints and shall be laid end to end without mortar on ends. As each course is completed, the end openings shall be filled with mortar and shall be rodded thoroughly to form a watertight seal between blocks.

8.07 Precast Manholes

All precast manhole sections and components shall conform to ASTM C-478-72 or latest subsequent revision. Precast manholes shall be those as shown on the City's approved materials list or approved by the City Engineer; but in all cases shall meet all provisions contained herein.

Precast manhole sections shall consist of circular sections with nominal inside diameters of 48" and 60". Heights of the sections may be in multiples of 12" at the option of the Contractor. The nominal wall thickness for 48" and 60" diameter sections shall be minimum of 5", and shall be designed to support all dead load and HS-20 traffic loads.

Reinforcement for precast manhole sections shall consist of a single cage of steel, placed at the approximate center of the wall section. The 48" diameter sections shall have not less than 0.12 square inches of circumferential steel per linear foot of barrel and the 60" diameter section shall have not less than 0.17 square inches of circumferential steel per linear foot of barrel. The cage steel shall be welded at every circumferential wire, or lapped 40 wire diameters and tied. The welded splice shall develop a tensile strength of 50,000 PSI of the wire diameter.

Joints between sections shall be tongue and groove, and shall provide 0.10' nominal annular space, height shall be 4". Joint surfaces and tolerances shall be as per ASTM C-361. All joints shall be sealed with either an "O" ring seal conforming to ASTM C 443, or with an approved Butyl Rubber Sealant conforming to Federal Specification SS-S-210A, AASHTO M-198, for Type B-Butyl Rubber as shown on the City's approved materials list or as approved by the City Engineer. Care is to be taken with the Butyl Rubber Sealant to make sure manufacturer's recommendations and overlaps are properly followed. Butyl Rubber Sealant shall be kept in original containers, stored in a cool area and kept free from foreign materials. Exterior of all joints shall be sealed per manufacturers recommendations.

Manhole steps shall be cast, drilled, or firmly grouted in place so as to ensure completely watertightness, any step holes shall not extend through the manhole wall. Steps shall be spaced at 16" centers and installed so as not to interfere with the reinforcing steel. Steps shall be No. 3 reinforcing rod encapsulated in a polypropylene plastic, as shown on the City's approved materials list or as approved by the City Engineer

No more than two lift holes shall be cast into each section. Holes shall be located so as not to damage reinforcing steel or expose it to corrosion. Steel loops may be provided for handling, in lieu of lift holes.

Precast conical eccentric transition sections shall be provided for reductions in diameters. The transition manhole sections shall conform to the cross-section as shown on City Standard No. 71B-4. The height of the transition section shall not be less than 24". Transition and barrel sections shall be free from fractures, cracks and surface roughness. All manhole components shall be capable of producing a watertight structure. Special Engineer's approval is required to use flat transition slabs or flat tops.

Manholes shall have precast concrete bottoms with integral walls extending to a minimum of six inches (6") above the top of the highest pipe line, except as shown on the plans. Precast manhole sections shall be affixed to a monolithic poured bottom to provide a watertight seal, and constructed in accordance with City Standard Drawing No. 71B-4. Pipe openings shall have a cast-in-place rubber sleeve or rubber boot complying with ASTM C 923 designed to provide a flexible watertight seal around the pipe and between the sleeve/rubber boot and the manhole as shown on the City's approved materials list or approved by the City Engineer. The cone section shall be the eccentric type, unless approved otherwise for a specific location for each use.

Inverts of the manhole shall be constructed as specified in Section 8.04 of these specifications. Inverts shall be poured-in-place, using the base section as form, and shaped as required for the proper flow. Separate pour pre-cast inverts may be used, approval required.

Holes or openings left in barrel sections for pipe connections shall be constructed so as to provide a minimum clearance between pipe and edge of opening as recommended by the manufacturer of the boot to be installed. This space may need to be mortared to produce a watertight seal and support the pipe, see the manufacturer's recommendations.

Alkalinity of the concrete used for the manholes shall be adequate to provide a Life Factor, AZ equal to the calcium carbonate equivalent times the cover over the reinforcement of no less than 0.35, for bases, risers, cones, transition and adjustment pieces.

Chemical Admixtures shall be as per ASTM C 494. Calcium chloride or admixtures containing calcium chloride shall not be used.

Any interior patching of wall penetrations shall be by using a two-component epoxy gel, solvent free, moisture insensitive, high modulus, high-strength, structural epoxy paste adhesive meeting ASTM C-881, Type I and II, Grade 3, Class B and C, Epoxy Resin Adhesive.

The masonry height for adjustment of grade above the cone shall be 12 inches maximum. **Butyl rubber sealant shall be provided between the frame, grade rings, and all manhole sections.**

Corrosion Protection for Manholes

1. Where corrosive conditions due to septicity or other causes are anticipated, consideration shall be given to providing corrosion protection on the interior of the manholes.
2. Where high flow velocities are anticipated, the manholes shall be protected against displacement by erosion and impact.

Tie-ins at existing manholes shall be constructed to the same standards as specified for new manholes herein. Any exceptions shall be as approved by the Engineer.

8.08 Cement

Cement used shall be of a high grade Portland Cement of a brand approved by the City Engineer. It shall meet AASHTO M-85-49 or latest subsequent revision. Cement shall be newly manufactured, well housed and preserved dry for use. No cement which has been injured by age or exposure shall be used.

8.09 Sand (Fine Aggregate)

All sand used shall be clean, sharp coarse grain sand and shall be free from clay, loam or organic matter and shall be subject to the approval of the City Engineer.

8.10 Water

Water used in Portland Cement mortar or concrete shall be free from oil, alkali, or other organic substances. If water is used from City's supply, the Contractor shall make arrangements with the City Utilities Department, and shall be required to meter such water used. **Backflow prevention and metered use will be required, the contractor shall supply all necessary equipment, materials, and labor. See section 2.02.**

8.11 Mortar

Mortar for brick work shall be composed of one (1) part Portland Cement to three (3) parts fine aggregate. During cold weather, mortar and brick work may be placed when the air temperature in the shade is 35° Fahrenheit or above and rising. It may not be placed when the air temperature in the shade is 42° Fahrenheit and falling.

8.12 Concrete

Concrete used shall consist Redi-mix concrete composed of Portland Cement, fine aggregate, coarse aggregate, water and admixtures to a design mix approved by the City Engineer. It shall have a twenty-eight (28) day compressive strength of 3000 PSI.

No water shall be added to the mix, except that called for in the mix design. Water added to the concrete enroute to the job site or on the job site shall be reason enough to reject the batch and have it removed from the job.

8.13 Manhole Frames and Covers

All castings shall be of good quality cast iron manufactured on Number One grade scrap or equivalent. No other casting shall be considered. Castings must be free from blow holes, sand holes and any other defect, and shall conform strictly to the dimensions shown on the City's Standard Drawing No. 71B-1. Gray Iron castings may be supplied with "no paint". Weight of the manhole ring and cover shall be approximately 310 Pounds.

Machining on certain parts of the manhole ring and cover shall be required. That portion of the manhole cover which is to be machined shall be the horizontal surface on the underside which comes in contact with the ring. This machined surface shall be 1--3/8" in width along the full circumference of the cover. That portion of the manhole ring or frame which is to be machined shall be the inside horizontal surface upon which the cover sits. This machined surface shall be one inch (1") in width, along the full circumference of the ring.

The machining described above shall be so accomplished so as to leave the machined surfaces in a true even plane, so that when the cover is placed on the ring in any position, the machined surfaces will be in full contact and even bearing, with no tilting or rocking motion. The machining to be done is in no way intended to decrease the thickness of the parts machined, but will have the dimensions shown on the City's standard drawing.

Locking Watertight Covers for Outfall Construction

Locking watertight frames and covers shall be used on outfall construction. Frames and covers shall be produced from ASTM A 48-74, class 30 iron. The minimum weight of the frame and cover shall be 310 pounds, as per Detail 71B-1.

The frame flange shall have four one-inch holes at 90 degrees for anchoring the flange to the concrete manhole with 4 each - 5/8" dia. bolts. The Contractor shall coordinate the bolt circle diameter with the manhole and frame suppliers. The cover shall have four holes for bolts at 90 degrees for locking the cover to the frame. The frame shall be tapped and the cover attached using four

hexhead 1/2" X 1-3/4" brass or stainless steel bolts. A neoprene gasket shall be provided between the cover and the frame seat. Butyl rubber sealant shall be provided between the frame, grade rings, and all manhole sections. Only frames and covers manufactured and tested in the U.S.A. will be allowed.

Manhole covers are to be provided with two one-inch diameter holes for ventilation, unless the Project Plans indicate that the manhole is to be vented to a specified elevation or a sealed manhole indicated. Vented manholes shall be as indicated on the project details and Std. Detail 71B-4a as revised 1/05/95 or later revision.

8.14 Concrete Encasing for Pipe

Encasing for pipes shall consist of plain 3000 PSI Class "A" concrete as a protective cover and reinforcement poured and formed to the cross-section as shown in City Standard Detail 71B-15.

This protective cover shall be required when shown or indicated on the plans, or when directed by the City Engineer.

8.15 Laying Pipe and Making Joints

The pipe shall be laid beginning at the lower or down-stream end of the line and shall progress continuously upstream. **Under no circumstances shall the Contractor leave out any section of the line to work on another portion further upgrade, without first securing written approval from the Engineer.**

Each joint of pipe shall be laid according to manufactures recommendations and, in accordance with latest revision of ASTM A-746 for Ductile Iron Pipe ASTM for PVC. Care shall be taken in placing pipe so that prior made joints are not disturbed. Competent pipe layers shall be required for pipe installation. Lines that do not exhibit true line and grade or have structural defects shall be corrected at the Contractor's total expense. Refer to Section 10.00 also.

At the end of each days work, the Contractor shall plug all pipe ends.

Trench Preparation

The Contractor shall prepare the pipe trench according to the "Project Details, and to the Standard Specifications" including but not limited to Sections 6.0, 8.0, 9.0, and 10.0 thereof and pipe manufacturer's recommendations.

Class B Bedding

Class B bedding shall consist of bedding the pipe in compacted granular material placed on a bed of granular material $\frac{1}{4}$ the pipe diameter but not less than 4"; after jointing of the pipe, extending the compacted granular material along the sides of the pipe to the level $\frac{1}{2}$ the diameter of the pipe, and the placement of compacted select backfill material to a depth of 6" above the top of the pipe, all as specified herein and detailed on the Drawings.

The granular bedding shall have a width equal to the width of the pipe trench and the length as indicated on the Drawings or as directed by the Engineer. Granular material used for Class B bedding shall be washed stone conforming to the gradation requirements of the N.C. Department of Transportation standard specifications for No. 57 standard size aggregate unless otherwise indicated on the plans. Granular material shall be placed in layers not more than 6" in thickness and each layer thoroughly tamped with approved mechanical tampers being extremely careful to completely fill all spaces under and adjacent to the pipe. The granular material shall be placed under and adjacent to the pipe by hand if necessary to completely fill all spaces under and adjacent to the pipe. All other aspects shall be as per Class D Bedding and Section 8.15. See City Standard Detail 71B-5

Class C Bedding

Class C bedding shall consist of a round bottom trench situated so that the width of the curvature is equal to $\frac{1}{2}$ the diameter of the pipe. All other aspects shall be as per Class D Bedding and Section 8.15 See City Standard Detail 71B-5.

Class D Bedding

Class D bedding shall consist of square cut trench bottom with bell holes. Wherever rock is encountered for Class D bedding conditions the rock shall be removed for at least 6" below pipe and replaced with compacted backfill to the required pipe bedding grade. See section 8.16 for backfill.

Concrete Encasement

Concrete encasement shall be made of **3000** psi class concrete and shall be constructed in accordance with details shown on the Drawings. The Contractor shall submit for approval of the Engineer his proposed method of supporting the sewer to maintain line and grade while the concrete encasement is being constructed. **Also, see section 8.14.**

Trench Stabilization (#57 washed stone) will be required when a wet or poor subgrade condition is encountered by the Contractor and when in the City Engineer's opinion other proper foundations cannot be provided. Refer to Standard Specifications Section 10.04 for additional requirements.

Rock Excavation

Excavation of hard rock, ledge rock, or boulders larger than two cubic yards which can not be ripped, clawed, etc., and or removed by conventional construction methods will be considered as Rock Excavation.

All blasting operations (use of explosives) shall be conducted in strict accordance with existing laws, rules, and regulations relative to the storage and use of explosives. Blasting shall be performed only by experienced personnel working according to accepted practice. The Contractor shall be responsible for securing all necessary permits including, but not limited to the City Fire Department. The Contractor shall comply with the City's Standard Specifications including, but not limited to Section 2.06. Extreme care shall be exercised by the Contractor to prevent injury to any existing pipes, water, sewer, gas, poles, wires, cables, drains, buildings or other structures or utilities either below or above the surface of the ground. The Contractor shall be solely responsible for any and all damage resulting from the use of explosives. Where there is any possibility of damage being caused by blasting it may be necessary to resort to drilling, wedging, and splitting to remove the rock.

Any rock encountered shall be excavated six inches (6") below the subgrade of the pipe bed.

8.16 Backfilling Pipe Trenches

As the pipe line is laid it shall be firmly bedded with suitable material on each side and thoroughly tamped on each side of and underneath the pipe. As soon as practical after the pipe has been laid and jointed, the trench shall be backfilled with select material and thoroughly tamped in six inch (6") layers to a depth of one foot (1') over the top of the pipe. Extreme care shall be exercised in backfilling and tamping to prevent damage to the newly made pipe joints and to the pipe itself. The trench shall then be backfilled with select materials, free of large stones, in six inch (6") horizontal layers and thoroughly compacted.

When the pipe is located in streets, roads, and driveways, the backfill shall be compacted as specified in Section 5.03, Paragraph (2).

8.17 Testing

The Contractor shall make the construction site and pipe installation available to the City Engineer or his representative at all times for performing tests on the materials and construction. These tests shall include, but not be limited to, the following:

(a) Compaction of Ditch

Backfill material shall be thoroughly tamped as specified in Section 5.05 of these specifications and shall be tested in accordance with AASHTO T99-57 test procedures for field density.

(b) Alignment and Grade

The lines shall be laid straight, within one fourth (1/4") inch variation per joint, but in all cases so that a full moon is visible from manhole to manhole. Lines which do not exhibit a true line and grade or have structural defects shall be corrected to meet these specifications.

The Contractor shall provide color video inspection services on new sewer lines and/or existing City maintained sewer lines.

Inspection of sewer lines shall be performed by experienced personnel trained in locating breaks, obstacles, and service connections by closed circuit television. The interior of the line shall be carefully inspected to determine the location of any conditions which may indicate current or future problems or non-compliance to the contract documents. Any such conditions shall be noted and corrected at the contractor expense.

The television camera used for the inspection shall be one specifically designed and constructed for such inspection. Lighting for the camera shall be to allow a clear, color picture of the entire periphery of the pipe. The camera shall be capable of a 360° viewing area. A backup camera shall be available on the project site. The camera shall be operable in 100% humidity conditions. The camera, television monitor, and other components of the video system shall be capable of producing color picture quality to the satisfaction of the Engineer, and if unsatisfactory, the equipment shall be replaced and no payment will be made for any unsatisfactory inspection.

The project name, location, date, manhole numbers, size and type pipe, and other information specific to the line segment being inspected shall be visibly displayed on the video viewing screen for a minimum of 10 seconds, prior to camera entry into the manhole.

Upon entry into the manhole, the surfaces of the manhole shall be videoed and potential defects noted. Prior to entering the sewer line, conditions of the manhole/pipe connection shall be videoed and potential defects noted.

When existing sewer flow depth, as measured in the first manhole upstream of the sewer segment being televised, exceeds 20% of the sewer line pipe diameter, the Contractor shall implement wastewater flow control methods, including but not limited to bypass pumping, at no additional cost to The City.

The rate of travel shall not exceed 30 feet per minute. At each line defect or service connection, the camera shall come to a complete stop and the subject panned. The footage meter count shall be clearly visible.

Printed television inspection logs shall be recorded by the Contractor clearly showing the distance from an adjacent manhole to discernable features such as broken or cracked pipe, defective joints, service laterals, and in existing lines presence of scale corrosion, grease buildup, storm sewer connections, and any other unusual conditions. A copy of the inspection logs shall be provided to the Engineer by the Contractor. A standard City video inspection log form shall be provided to the Contractor by the Engineer.

The Contractor shall provide color video recordings of all the subject lines, the recordings shall provide a visual and audio record of problem areas of the lines before and after any rehabilitation. The video recording shall include, at a minimum, a display of the footage meter and a display of the manhole segment number being televised. Where appropriate, comments should be included by concurrent audio recording on the recording or electronic display. Video recording playback shall be at the same speed that it was recorded. Slow motion or stop-motion playback features may be supplied at the option of the Contractor.

The Contractor shall carry out his operations in strict accordance with all OSHA and manufacturer's safety requirements. Particular attention is drawn to those safety requirements involving entering confined spaces.

Cleaning shall be the responsibility of the contractor. Any hang-ups shall be the responsibility of the Contractor, the contractor shall remove the camera and repair any damage to the sewer line.

(c) Infiltration/Exfiltration

- (1) The Contractor shall provide the equipment, materials and labor necessary to check the lines for infiltration or exfiltration before they are put in service. Infiltration or exfiltration in excess of one hundred (100) gallons per

day per inch-mile of sewer will result in having the Contractor go over the lines, ascertain where the leakage exists, and repair the lines to the extent necessary to bring the infiltration or exfiltration down within acceptable limits. The Contractor shall test only pipe of the same diameter and for such lengths as approved by the Engineer.

- (2) Exfiltration tests shall be conducted on all gravity sewer lines, unless authorized otherwise by the City Engineer. The line under test shall be plugged and filled with water in such a manner that the maximum hydrostatic head at any point in the line would not exceed ten feet of water. All manholes shall be tested. The exfiltration from the line under test shall not exceed 100 gallons per inch of nominal pipe diameter per mile of pipe per twenty-four hours. The amount of exfiltration shall be measured by the inspector using methods specified by the City Engineer for the particular situation.
- (3) Where ground water is encountered during construction, the Contractor shall furnish labor, equipment, and materials including pumps, and shall assist the Engineer in making infiltration tests of the completed sewer section before it can be placed in service or connected to any other lines. The Contractor will furnish and install the measuring weirs or other measuring devices. The length of line to be tested at any time shall be subject to the approval of the Engineer. The total infiltration shall in no case exceed 100 gallons per inch of diameter, per mile of pipe per day. The test period shall be twenty-four hours, and if the quantity of infiltration is in excess of the maximum allowable, the leaking joints shall be relaid if necessary or other remedial construction shall be performed by and at the expense of the contractor. The section of sewer shall then be retested after repairs are completed to determine compliance with the specifications.
- (4) The infiltration in the line shall be checked thru a low pressure exfiltration air test. The sanitary sewer pipe and lines shall be capable of reaching a constant pressure of 4 psig within the time specified in Table 1 and shall be capable of maintaining the pressure for the time limit specified in Table 2.
- (5) All tests shall be made in the presence of the contractor or his representative and the Engineer.
- (6) Any and all work necessary to bring the line into conformance with the infiltration/exfiltration specifications shall be performed by the contractor at no cost to the City. All apparent sources of infiltration shall be repaired. The City reserves the right to require that the lines be tested in sections such that the maximum allowable static head is imposed on as much of the line as is practicable.

- (7) Where a stream is not readily available as a source of water to use for testing, water from the City system may be used, providing proper notification procedures for operating valve hydrants will be required.
- (8) Materials and construction methods called for in these specifications are of such nature as to insure maximum protection for the sewer from infiltration. The contractor shall be responsible for the sewer conforming to the above limits for a period of one year from date of final acceptance.

TABLE 1
 TIME REQUIRED TO PRESSURIZE To 4 PSIG*
 TIME (IN MINUTES)

PIPE SIZE	<u>REACH OF LINE TESTED</u>						
	20'	100'	200'	300'	400'	500'	600'
4"	6 sec.	0.5	1.0	1.5	1.9	2.4	3.0
6"	12 sec.	1.0	2.2	3.2	4.4	5.8	6.4
8"	23 sec.	1.9	3.8	6.0	7.6	9.6	11.6
10"	35 sec.	2.9	5.8	8.8	11.6	14.6	17.6
12"	50 sec.	4.2	8.4	12.6	16.8	21.2	25.6
15"	1.3 min.	6.6	13.2	19.8	26.4	35.0	39.6
18"	1.9	9.4	18.8	28.2	37.6	47.0	56.4
21"	2.5	12.6	25.2	37.8	50.4	63.0	75.6
24"	3.4	17.0	34.0	51.0	68.0	102.0	136.0

* This table is based on the compressor unit mounted on a Cherne Air-Loc Testing unit assuming 5 cfm capacity.

TABLE 2
 MINIMUM TEST TIME FOR VARIOUS PIPE SIZES

NOMINAL PIPE SIZE IN. MIN/100 FT.	T (TIME)	NOMINAL PIPE SIZE IN. MIN/100 FT.	T (TIME)
3	0.2	21	3.0
4	0.3	24	3.6
6	0.7	27	4.2
8	1.2	30	4.8
10	1.5	33	5.4
12	1.8	36	6.0
15	2.1	39	6.6
18	2.4	42	7.3

The low pressure air test shall be performed as specified in latest revision of ASTM C 828 for VCP and ASTM C924 for RCP. If the line pressure drops more than 1 PSI during the required test time, then the section of pipe has failed the test.

Furthermore, in testing any sanitary sewer line, the infiltration/exfiltration rate shall be less than 100 gallons per inch diameter of pipe per day per mile of sanitary sewer. See Section 8.17(c) (1), (2), and (3).

8.18 Taps/Service Connections (Sewer)

Only authorized personnel of the City of Gastonia Utilities Department shall be permitted to make sanitary sewer taps unless the developer has received permission, in writing, from the Director of TRU or designated representative, for an approved Utilities Contractor to make these taps.

All taps shall be made in strict conformance to City requirements. No tap shall be made before the tests are complete and approved.

Sanitary sewer service connections may be installed by the developer of property upon request. The Application (form supplied by the City) should be completed and sent to the Director of TRU. Material for these services will be obtained by the contractor.

Materials used in making the sanitary sewer service connection shall conform to Detail 71B-19.

Fernco Donut required when tying into tees. (See Section 8.03 for adapters and further requirements for taps into PVC Sewer Pipe.)

All material will be inspected for compliance by TRU inspector prior to installation. All services will be inspected prior to backfill operation for compliance. The backfill and compaction operation shall be according to standard procedure, and the Standard Specifications including Section No. 5.05.

All taps shall be made in a method approved by the TRU, and according to Standard Details including 71B-19. All taps installed by cutting into the sewer main shall be made with the use of a tapping/coring machine if saddles are used. (The use of a hammer and chisel or other manual impact methods will not be allowed.)

Any customer service connection required to be installed into any outfall sanitary sewer line will be tied into either a proposed manhole shown on the Project Plans or into an added manhole as required and approved by the City Engineer.

See section 8.21 for smoke testing requirement on existing taps to be reconnected.

Pavement cuts across public streets for services shall be avoided. The contractor shall install these lines using an air pressure driven, pneumatic "mole" or an auger type machine. If an open cut is unavoidable, the contractor shall secure approval from the City Engineer prior to making any street cut for a service line.

All tap locations shall be shown on the "as-built" plans and shall be marked on the top of the curb with "arrow" indicating the water and "X" indicating the sewer .

See Section 2.34 for additional as-built requirements.

8.19 Force Mains

Pipe material for force mains shall be either Cement Lined Ductile Iron Pipe as specified in Section 9.03 herein or PVC AWWA C-900 as specified in Section 9.02 herein.

All force mains shall be tested in accordance to Section 9.12 herein with the minimum test pressure being 100 PSI.

All blocking/restraining for the fittings shall be designed to withstand the test pressure.

A properly sized and approved air release valve in a standard manhole shall be provided at all high points where a negative pressure of 10' may be produced. A weep pit of No. 57 stone shall be provided similar to Standard Detail 71B-17. Air release valves shall be approved by the City Engineer.

8.20 Piers/Piles/Concrete Supports

This item shall include all labor, materials, and equipment necessary to construct piers according to the Standard Specifications, Standard Details, and Project Plans.

All concrete used shall be 3000 psi concrete as specified in Sections 846, 848, 1000, and 1024 of the NCDOT Standard Specifications for testing and curing requirements. All reinforcing used shall have standard deformations and a minimum yield strength of 40,000 psi. All splices shall be as required by the engineer, but in no case shall a lap splice be less than 24 bar diameters, or no less than 12 inches. Two layers of wool or polyester felt at least 125 mils in thickness with Graphite Grease shall be installed between the pipe and the pier cap and pier straps.

When piles are required by the Project Plans and the Engineer, the piles shall be 8" butt diameter wood piles, treated with approved rot-proofing as applicable. The piles shall be driven as specified in Standard Details 71B-14 and 71B-15. When the plans call for piles and rock is encountered, the Engineer may delete the requirements for piles. In deleting the pile requirement, the rock shall be undercut as directed by the Engineer to give an adequate footing.

Piers shall be spaced according to the aerial crossing specification. (not more than 40 feet on centers)

8.21 Dry Bore and Jack/Tunneling

A. Dry Bore and Jack

The Contractor shall supply all labor, material, and equipment necessary to install the sewer line without open cutting the pavement where indicated on the plans. The encasing pipe may be jacked through dry bores slightly larger than the pipe, bored progressively ahead of the leading edge of the pipe. Continuous checks shall be made as to the elevation, grade and alignment of each successive section of pipe as well as the tracks upon which the boring rig travels.

The boring operation shall be continuous to its completion.

In the event an obstruction is encountered during the boring and jacking, the auger is to be withdrawn and the excess pipe cut off, capped, and filled with 1:3 Portland Cement Grout at sufficient pressure to fill all voids. A new site will then be picked for a new bore. If open cut is allowed, then the aborted length shall be utilized.

The carrier pipe shall be protected so as to prevent as much foreign material from entering as is possible. Carrier pipe shall be tested in the same fashion as all other pipe in this section.

The operation across the street right-of-way must conform to the requirements of the Permittee. The Contractor shall execute all necessary agreements and/or permits before entering upon or commencing any work on the street right-of-way.

The gravity sewer line shall be Pressure Class 350 zinc coated cement lined ductile iron pipe.

The minimum gauge or wall thickness shall correspond to the size of casing selected from the following chart; however, the Contractor shall be responsible for selecting the gauge consistent with his operation.

Gauge Table for Railroad Crossings
Minimum Wall Thickness for Smooth Steel Casing Pipe for E80 Loading
(ASTM A139 Grade B; AWWA C-200)

Nominal Diameter (inches)	When coated or cathodically protected	When not coated or cathodically protected
	Nominal Thickness (inches)	Nominal Thickness (inches)
12 3/4 and under	0.188	0.188
14	0.188	0.250
16	0.219	0.281
18	0.250	0.312
20 and 22	0.281	0.344
24	0.312	0.375
26	0.344	0.406
28	0.375	0.438
30	0.406	0.469
32	0.438	0.500
34 and 36	0.469	0.531
38	0.500	0.562
40	0.531	0.594
42	0.562	0.625
44 and 46	0.594	0.656
48	0.625	0.688
50	0.656	0.719
52	0.688	0.750
54	0.719	0.781
56 and 58	0.750	0.812
60	0.781	0.844
62	0.812	0.875
64	0.844	0.906
66 and 68	0.875	0.938

70	0.906	0.969
72	0.938	1.000

The exterior coal-tar enamel protective coating is to be supplied in accordance with AWWA C-203, the steel casing pipe minimum thickness may be reduced by 0.063 inches, as per the table for E80.

Gauge Table for NCDOT (Street) Crossings (H-20 Loadings)

<u>Diameter Inches</u>	<u>Smooth Steel Pipe</u>	
	<u>Minimum Thickness, Inches</u>	
15-24	0.25	ASTM A139, Grade B; AWWA C-200

SUPPORTS: Carrier pipe shall be supported on either approved “spider” supports as indicated on the plans (not less than two supports per length of pipe), or lumber skids (pipe barrel shall bear continuously on skids). Lumber shall be Cedar, or No. 2 or better Southern Yellow Pine. Lumber shall be pressure treated with approved rot-resistant treatment for ground contact. Method of treatment in accordance with the applicable portion of the AWWA manual standards. All timbers shall be cut to size before the material is given the preservative treatment. See Standard Detail 71B-25.

STAINLESS STEEL BANDS: One-half inch wide by 0.020-inch thick, 304 stainless steel bands, or equal.

Prior to the start of the work, submit satisfactory evidence to the Engineer that all bond and insurance coverage requirements called for by the Permittee have been complied with. All proposed construction methods and materials for the undercrossing shall be approved by the Engineer and Permittee prior to the crossing operation, and no construction shall be started until written approval to proceed from the Permittee has been submitted to the Engineer.

PLACING SEALS AT ENDS OF CASING: After the carrier pipe has been tested and approved, place 3/16-inch thick black neoprene rubber seals, or 8" masonry plug, as shown on the Drawings and Standard Detail 71B-25. Encroachment approval may require weep pits.

B. Tunneling

The tunnels on this project shall be constructed wherever required by the Department of Transportation, Railroad Company (NCDOT/R.R.) or Plans, as applicable, and where other construction methods are not feasible due to field conditions encountered, and in accordance with these and AREA or AASHTO specifications, as applicable. The liner plates to be used shall be the 4 flange type. The liner plates shall be galvanized on both sides by the hot dipped process. The minimum thickness of the plates shall be as indicated on the Drawings.

A coating of prime western spelter or equal shall be applied at the rate of two ounces per square foot, of double exposed surface. Spelter coating shall be of a first class commercial quality, free from defects, such as blisters, flux and uncoated spots.

The steel liner plates shall be given a bituminous coating meeting North Carolina Department of Transportation specifications for bituminous protected corrugated metal pipe with a minimum thickness of 0.05".

The space outside the liner plates shall be held to a minimum and grouted with a 1 to 3 portland cement grout of 50 psi through 2" openings on 4' - 6" centers provided in the top of the steel liner plates. This grouting operation shall be done with the installation of the liner plates so that at no time will the grouting operation be further than 25' from the front end or head of tunnel construction. At the end of each day's operation, the space outside the liner plates shall be grouted whether 25' or less. Grout shall be forced into each grout hole. If the grout from one hole should flow along the liner plate so as to plug the next grout hole, the plugged hole shall be opened by punching through the grout layer so that each hole may be used for grouting. The grouting operation shall be continued at each hole until all spaces outside the liner plates are filled and no grout will flow.

The tunneling operations shall proceed only a distance sufficient for placing one section of the tunnel liner, the tunnel liner placed before proceeding further, and at no time will jetting be allowed.

Blasting will not be permitted.

The Contractor and any of his subcontractors performing the work on the Railroad rights-of-way in connection with tunneling operations, shall furnish to and be approved by the Division Engineer/Manager of Insurance of the Railroad Company, a certificate of workmen's compensation and employer's liability insurance, and public liability insurance covering bodily injury. Such insurance is to include a Contractual liability endorsement covering the obligations assumed by the Contractor in agreeing to install the pipeline. The certificate is to show that explosion, collapse and underground insurance coverage is provided. The certificate shall include a statement that the insurance is not to be changed or canceled for a period of one year after completion and acceptance of

the work by the Owner and the Railroad. The certificate is to be countersigned by an authorized North Carolina resident agent with name and address of the agent denoted thereon. The certificate is to make reference to the project and county.

The Contractor shall furnish to and be approved by the Railroad Division Engineer/Manager of Insurance, an original policy of Railroad Protective Liability Insurance (RPLI) in the name of the Railroad Co. (Company). Said Policy shall have a combined single limit of \$2,000,000.00 each occurrence and \$6,000,000.00 aggregate. The insurance shall be written on ISO/RIMA Form No. CG 00 35 11 85 and include endorsement form No. CG 28 31 11 85. The original Railroad Protective Policy shall be submitted to and approved by Company prior to commencement of construction, maintenance of said Facility or entry on Company's property. Said RPLI coverage is available through the Railroad Company's Blanket Policy.

After approval of insurance certificate, the Contractor shall notify NCDOT/R.R., and City 72 hours in advance of the start of the tunnel operation.

The entire operation shall be subject to inspection by the NCDOT/RR and the Engineer or Inspector on the project shall have full authority to stop work if, in his opinion, it shall cause any damage to the roadway section or endanger traffic.

The Contractor shall reimburse the NCDOT/RR for repair costs, should any settlement or damage appear to the roadway within a period of one year after completion of the tunneling operations.

After the tunneling operations have been completed, the vertical shoring for pits, surplus fill and material shall be removed from the site. The site shall be returned to its original condition, seeded and mulched where required, and the area shall be left in a neat and satisfactory condition.

8.22 Abandonment and Shutdown of Existing Operations of Utilities

The Contractor shall supply all necessary labor, equipment, and materials to plug and abandon in place the existing sanitary sewer outfall system as indicated on the Project Plans.

Continuous operation of the City's existing sewer system is of critical importance.

Connection to existing services or utilities, or other work that requires the temporary shutdown of any existing operations or utilities shall be planned in detail with appropriate scheduling of the work and coordinated with the Utility Customer and the Engineer. The approved schedule for shutdown or restart shall be indicated on the Contractor's Progress Schedule, and advance notice shall be given in order that the customer and the Engineer may witness the shutdown, tie-in, and start-up.

The Contractor shall be responsible for notification of each property Owner prior to disruption of service, except in the event of an emergency situation. The Contractor shall coordinate his activities with any non-City owned utility.

Only City personnel shall operate any valves and controls on the City's existing utility systems.

The testing, acceptance, tap and mainline tie-overs shall be coordinated so as to eliminate any disruptions in service. A spill, leakage, or by-pass of wastewater shall not be allowed, the Contractor and his sureties shall hold harmless and defend the City from any penalties which may result thereof.

All materials and equipment (including emergency equipment) necessary to expedite the tie-in shall be on hand prior to the shutdown of existing services or utilities.

All existing sewer taps shall be smoke tested (or other approved method) prior to reconnection, to make sure that no connection of storm water or other identified illegal inflow is present. It shall be the Contractor's responsibility to supply all labor, materials, and equipment to perform these tests and to notify the residents of such planned tests. It will be the City's responsibility to notify the Owner of any illegal inflows found, and to be sure all remedies are in place prior to allowing the Contractor to connect the tap to the new sewer line, and that the remedies are completed in a timely manner to allow the Contractor to complete his construction without any undue delay.

8.23 Demolition of Existing Manholes

Following completion of replacement of sewer lines and connection of house laterals, plug all sewer lines at each manhole on the abandoned system with non-shrink grout. Remove the abandoned manholes to depth of 4 feet below grade and fill the void with Washed Stone to 18-inches below grade. The washed stone fill shall be covered with approved filter fabric. Fill the remaining with top soil. Where the manhole is in a paved area the remaining shall be filled with ABC to the bottom of the utility cut patch. Restore all affected areas.

8.24 Progress of Pipe Line Construction

The work shall proceed in a systematic manner so that a minimum of inconvenience will result to the public in the course of construction. It is, therefore, necessary to confine operations to as small a length of work area per crew as is practical. Normally, the trenching equipment shall not be farther than 200 feet ahead of each pipe laying crew or such distance as necessary to provide maximum safety. Backfill the trench so no section of properly laid pipe is left uncovered longer than is absolutely necessary. The safety conditions of open excavations shall be the Contractor's responsibility. Completely backfill and clean up after each section of pipe has been inspected and approved.

8.25 Protection of Existing Structures

Existing structures adjacent to the project are susceptible to vibration and settlement damage. The Contractor is advised that he must take extreme care and in some cases must implement special construction procedures when proceeding with his work to assure that these structures are not damaged.

The Contractor shall exercise extreme care and take all precautions during excavation and construction operations to prevent damage to any existing structure. Any damage caused by the Contractor shall be reported immediately to the City of Gastonia and such work shall be repaired and/or replaced by the Contractor in a manner approved by the City of Gastonia. All costs to repair and/or replace any damage to existing structures shall be the sole responsibility of the Contractor and such repair or replacement shall be performed expeditiously without cost to the City of Gastonia.